On the Sweepstakes claim, which is the most extensively explored, are the copper deposits of contact-metamorphic origin which have been mentioned above. These deposits, as already stated, are composed of garnet, tremolite, and other contact-metamorphic minerals, which at some places are intergrown with pyrite, chalcopyrite, bornite, galena, and zinc blende. Locally the copper-iron sulphides, which are unquestionably primary, are coated over with secondary copper glance. Here and there the copper sulphides have oxidized to copper carbonates and iron oxides, but the oxidation is not complete, even at the surface, and at some places less than 10 feet below the surface the sulphides are much more abundant than the carbonates and oxides. Shipments of 210 tons of ore from this claim averaged 70 ounces of silver to the ton, 10.4 per cent of copper, and 2.8 per cent of lead. There is a considerable tonnage of low-grade ore partly developed. It will probably be found that the high-grade ore is restricted to that which carries chalcocite-coated sulphides, or to that which has resulted from the oxidation of such ore. Figure 15 is a sketch of the Delmas property.

Other claims.—The Kenilworth claim, north of the Standing Elk; the Sylvania claim, west of the Standing Elk; and the Blue Belle, northwest of the Sylvania, have each produced considerable ore from workings which were inaccessible when the camp was visited by the writer. The principal deposits of these mines appear to resemble those of the Standing Elk rather than the contact-metamorphic deposits of the Delmas group.

MINERAL HILL.

LOCATION AND HISTORY.

(1910)

Mineral Hill is a mining camp situated about 5 miles southeast of Mineral, a station on the Eureka and Palisade Railroad. It is at the north end of a small ridge of the same name which rises some 700 feet above the floor of Pine Valley and forms a foothill on the west slope of the Pinyon Range.

The deposits, which outcrop along the summit of Mineral Hill, were discovered by a party of prospectors from the Reese River district in 1868 and were sold soon afterward to a San Francisco company. In the early seventies the mines were sold again to a London corporation, which operated them with some success until 1878. Parker, Spencer & Co., who were mining at the south end of the hill, acquired the holdings of the London company in 1880 and operated the mines and mill until 1887. Since that time the mines have not been worked actively. The total production of Mineral Hill, so far as it can be estimated from various reports, is probably a little more than $6,000,000, practically all of which is silver. The mines are now in the hands of the Mineral Hill Consolidated Mining

Company, with headquarters in New York, and this company plans to work the low-grade ore that remains in the dumps and mines.

The ore was treated in two silver mills, one of which was equipped with 15 and the other with 20 dry-crushing stamps. The 15-stamp mill was in operation for a number of years, but the larger mill was sold and removed after it had been running for only a short period. The mills were equipped with Stetefeldt roasters to work the ore by the Reese River process, but it was found that the additional cost of roasting was greater than the increased saving effected, and so the Washoe process with dry crushing and raw amalgamation was early adopted. The details of treatment are given by M. Eissler in the "Metallurgy of silver," page 154. The present owners plan to treat the ore by concentration and cyanidation.

GEOLOGY.

The Pinyon Range to the east of Mineral Hill is made up of steeply dipping sedimentary rocks consisting of Paleozoic limestones, quartzite, and shales. The ore deposits are in a gray crystalline limestone, which, along the crest of Mineral Hill, dips from 45° to

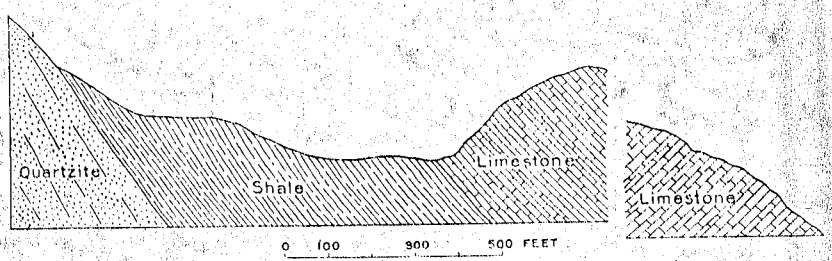

FIGURE 16.—Sketch illustrating the structure at Mineral Hill.

75° E. This limestone rests upon a dark shale that is exposed along the west slope of the hill and in the Taylor tunnel below the ore bodies. On the west slope of the Pinyon Range, east of the south end of Mineral Hill, the shales, which here are at least 600 feet thick, dip westward below the limestone and rest upon a great series of quartzites which are mapped as Ogden (Devonian) in the atlas of the Fortieth Parallel Survey. Figure 16 is a sketch in cross section drawn westward through Mineral Hill.

The structure appears to be synclinal, the axis of the syncline lying somewhere to the east of the crest of Mineral Hill and east of the outcrops of the ore deposits. The limestone that contains the ore bodies is about 400 feet thick, but it is probably only the lower part of a formation which may be thicker, the upper portion having been eroded away at this place. The limestone is cut by three narrow dikes of a decomposed intruding igneous rock, the least-altered specimens of which are composed of quartz, sericite, calcite, and limonite. These dikes are approximately parallel, strike eastward, and dip to the south at high angles.

ORE DEPOSITS.

The principal workings of Mineral Hill are open cuts and shallow stopes which are closely spaced along a zone from 200 to 300 feet wide and about 1,200 feet long. The open cuts are from 25 to 75 feet long and their width is somewhat less. The stopes range from 10 to 40 feet in width and do not extend downward more than 150 feet below the surface. The Queen tunnel is driven southward from the north end of the workings, exploring a large part of the ore zone, and ore chutes are raised to the ore bodies near the surface. About

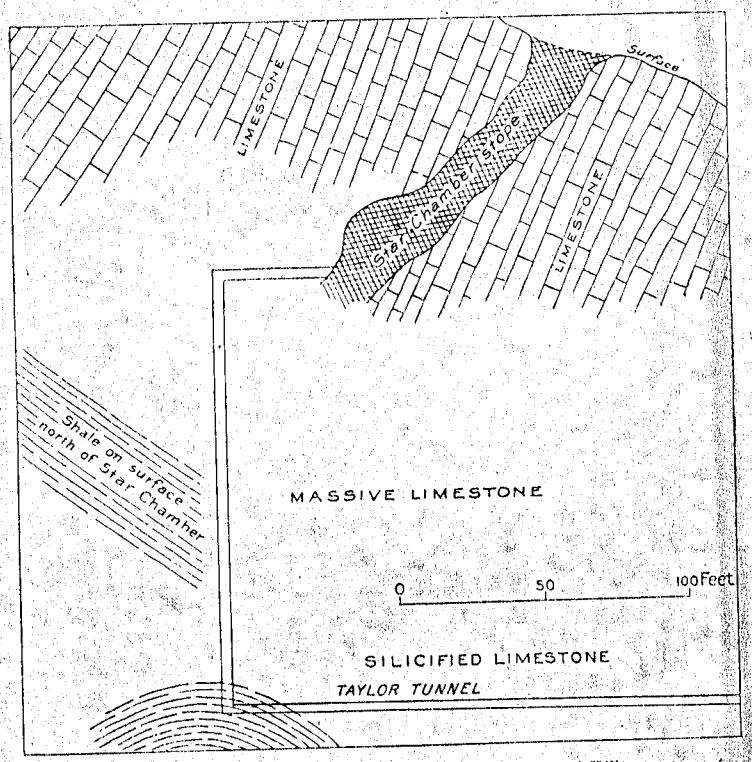

FIGURE 17.—Cross section of Star Chamber stope, Mineral Hill.

150 feet below the Queen adit the Taylor tunnel is driven westward to intersect a winze from the Queen.

The deposits are very siliceous and are eroded less rapidly than the country rock; consequently they form bold outcrops, and the zone along which a maximum of mineralization has taken place has remained longer at the surface, the hard rock tending to monopolize the outcrop. The configuration of the hill is probably due to the resistance offered to erosion by the large masses of quartz. The ore bodies are chambers or irregular replacement deposits which cut

across the bedding of limestone. Along the line of the principal deposits the limestone dips steeply eastward, as shown in figure 17. In places near the ore the limestone is strongly sheeted or brecciated, the open spaces being filled with white calcite, which contrasts strikingly with the gray limestone bands of the original rock, producing gneisslike banding. At some places the limestone is replaced by the quartz and sulphides and the ore grades into the country rock; elsewhere the limestone is brecciated, and the small angular fragments of limestone, which are cemented by white quartz, show no evidence of having been dissolved, the sharp edges remaining intact. The relations indicate that the composition of the solutions changed while the deposits were being formed—that they had spent their power to replace the limestone before deposition ceased. The ore, deposited by solutions which were capable of replacing the limestone, is richer in the sulphides and in silver than the quartzose material that simply filled the open spaces.

The minerals of the ore are quartz, calcite, barite, silver chloride, argentite, gray copper, galena, zinc blende, copper carbonates, pyromorphite, lead carbonate, pyrite, and iron and manganese oxides. According to Eissler,[a] polybasite, stephanite, bromide of silver, and molybdenite are also present. Some of the ore carries a considerable quantity of galena, but in most of it the proportion of sulphides is small, the gangue minerals constituting considerably more than 90 per cent of the bulk of the rock. A large proportion of the ore carried from 100 to 200 ounces of silver to the ton, although ore which carried as low as 25 ounces was worked. The ore bodies are closely spaced along a zone of fracturing that strikes northward and has been extensively explored for a distance of about 1,500 feet. So far as developed, the ore is in the main at the surface or less than 100 feet deep. Most of the ore bodies dip about 45° E.; some are vertical and one dips steeply westward. The silicified zone is cut by a number of fissures which strike east and dip about 60° N., and in two of the ore chambers these fissures form the south wall of the ore body. Possibly these fissures have faulted the ore, but the limestone has been silicified on both sides of them and the ore zone is not displaced by them to any great extent.

From the Star Chamber stope was removed a wide mass of ore, extending from the surface to the level of the main adit with a dip of about 40°. This stope, which is shown in figure 17, is practically continuous toward the south with the Giant stope, a huge cavity about 50 feet in diameter from which small tortuous stopes extend in several directions. Still farther south along the zone of silicification are the Live Yankee, the Austin, and several other stopes of smaller size. The localization of the ore bodies is due to the intensity

[a] Eissler, M., loc. cit.

of fracturing and sheeting in the ore zone, the larger deposits having formed where there was a maximum amount of shattering.

The shales which underlie the limestone are crumpled, fissured, and cut by small veins of white quartz, but are not known to carry deposits of economic value. Below the ore bodies some development work has been done in the shales, but this prospecting was not thorough and the present owners plan further exploration at the lower level. Work to the east of that already done in the Taylor tunnel may prove more productive. To judge from the dip of the beds the limestone will probably be found at greater depth at that place than in the ground directly below the outcropping deposit.

ALPHA.

Alpha is a small camp about 15 miles south of Mineral Hill and 5 miles east of Alpha station on the Eureka and Palisade Railroad. The principal claims are the Arizona, Utah, Oregon, and Idaho. These claims have been developed by a number of shallow inclines and short tunnels, driven for the most part in silicified limestone which carries a considerable amount of barite and a small amount of the metalliferous sulphides. A concentration plant equipped with ten stamps and five vanners was built at Chimney station, about 3 miles west of the mines, but the treatment was presumably unsatisfactory, as only a small amount of ore was put through the plant. The country rock is Devonian limestone. It dips from 30° to 40° E. and presumably rests upon the quartzite which outcrops as a marginal band in the low hills west of the mines and is mapped as Ogden by the Fortieth Parallel Survey. The ore deposits outcrop boldly at the surface, some of them forming more or less noticeable reefs. The metalliferous minerals include freibergite, galena, zinc blende, pyrite, and copper carbonates, and in some places barite forms more than half of the ore. The lodes are sheeted zones and replacement deposits in limestone, of which some follow the stratification and some cut across the bedding.

CORTEZ RANGE SOUTH OF HUMBOLDT RIVER.

GENERAL FEATURES.

The Cortez Range extends from Carico Peak northeastward about 50 miles to Humboldt River and from this point northward some 40 miles to Independence Valley in the region of Tuscarora. The range north of Humboldt River has been described. That portion which lies south of the Humboldt includes a part of the Safford district, near Palisade, and the Mill Canyon and Cortez district, on the slopes of Tenabo Peak. The country between Mill Canyon and the Safford district was not traversed in this reconnaissance, and the